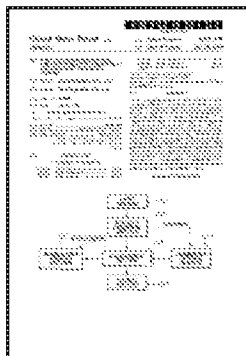Google patents | high speed pattern matching storing | Search Patents

Word and pattern recognition through overlapping hierarchical tree defined ... Katsuki Minamino

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A voice recognizing method in which a plurality of voice recognition objective words are provided. Scores are accumulated for an unknown input voice signal as compared to the voice recognition objective words by using parameters which are calculated in advance. Upon receipt of an unknown ...

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U.S. Classification
704/255; 704/245; 704/237

International Classification
G10L 908

View patent at USPTO

Citations

Patent Number	Title	Issue date
RE31188	Multiple template speech recognition system	Mar 22, 1983
4837831	Method for creating and using multiple-word sound models in speech recognition	Jun 6, 1989
5033087	Method and apparatus for the automatic determination of phonological rules as for a continuous speech recognition system	Jul 16, 1991
5537488	Pattern recognition system with statistical classification	Jul 16, 1996
5546499	Speech recognition system utilizing pre-calculated similarity measurements	Aug 13, 1996

5621859	Single tree method for grammar directed, very large vocabulary speech recognizer	Apr 15, 1997

Referenced by

Patent Number	Title	Issue date
6334102	Method of adding vocabulary to a speech recognition system	Dec 25, 2001
6449591	Learning apparatus, learning method, recognition apparatus, recognition method, and recording medium	Sep 10, 2002
7192283	System and method for visual analysis of word frequency and distribution in a text	Mar 20, 2007
7359720	Mobility extended telephone application programming interface and method of use	Apr 15, 2008

Claims

What is claimed is:

1. A voice recognizing method, comprising the steps of:

    providing a plurality of voice recognition objective words;
structuring said voice recognition objective words into a hierarchical structure having a plurality of levels based upon correlation values indicative of similarities between each pair of voice recognition objective words;
inputting an unknown voice signal;
accumulating scores for the voice recognition objective words which are related in said hierarchical structure to a voice recognition word in a higher level, which word in said higher level receives a high score for said unknown input voice signal by using parameters which are calculated in advance; and extracting and recognizing a corresponding voice recognition objective word to said unknown input voice signal.

2. The voice recognizing method according to claim 1, wherein each pair of voice recognition objective words is arranged within said hierarchy in the order of increasing scores on the basis of values based on expected values of scores calculated by voice data corresponding to the recognition objective words.

3. A voice recognizing method, comprising the steps of:

    providing a plurality of voice recognition objective words;
structuring said voice recognition objective words into a hierarchical structure by using correlation values between each pair of voice recognition objective words;
inputting an unknown voice signal;
accumulating scores for the voice recognition objective words for said

unknown input voice signal by using parameters which are calculated in advance;

extracting and recognizing a corresponding voice recognition objective word to said unknown input voice signal;

calculating scores for said unknown input voice signal compared to the objective words by calculating scores for voice recognition objective words of a proper, first hierarchy level in the hierarchical structure, calculating scores for words on a next hierarchy level immediately under the first hierarchy level associated with words having high scores in said first hierarchical level, calculating scores for words on a hierarchy level immediately under said next hierarchy level associated with words having high scores in said next hierarchical level, and repeating said score calculating until lowest hierarchy level is reached; and

selecting at least a word having the highest score from the words whose scores are calculated.

4. The voice recognizing method according to claim 3, further comprising the steps of:

storing the calculated scores of words; and
using the stored scores when selecting a word to prevent repetitive score calculation from being performed.

5. The voice recognizing method according to claim 3, further comprising the steps of:

preparing probability models for the plurality of voice recognition objective words;

determining a plurality of state transition sequences on the basis of state transition probabilities of probability models corresponding to the voice recognition objective words;

determining a symbol sequence for each state transition sequence on the basis of an output symbol probability corresponding to the state transition;

calculating a generation probability of the obtained symbol sequences for probability models corresponding to the voice recognition objective words;

structuring the voice recognition objective words into a hierarchical structure by using correlation values between each pair of voice recognition objective words based on the generation probability;

generating probabilities of the unknown input voice signal in accordance with the probability models; and

selecting a recognized corresponding voice recognition objective word according to the generated probabilities.

6. The voice recognizing method according to claim 5, wherein said plurality of state transition sequences are determined on the basis of the probabilities of the probability models corresponding to the recognition objective words, each said symbol sequence is determined from each state transition sequence on the basis of an output symbol probability corresponding to the state transition, and said generation probabilities of the plurality of obtained symbol sequences are calculated for the models corresponding to the words, further comprising the steps of:

arranging all the voice recognition objective words in the order of increasing expected values of the generation probabilities; and

setting the correlation values between the pairs of voice recognition objective words in accordance with the relative positioning of the arranged voice recognition objective words.

7. A method of forming information of pattern recognition objects for recognizing patterns in which scores are accumulated for the pattern recognition objects when compared to an unknown input pattern by using parameters which are calculated in advance, thereby allowing a corresponding pattern recognition object to be recognized, comprising the steps of:

determining correlation values between each pair of recognition objects;
grouping the pattern recognition objects in decreasing order, on the basis of said correlation values;
selecting a pattern recognition object serving as a typical object of a group;
regrouping said pattern recognition objects to form groups each having a relationship between a typical pattern recognition object and a set of pattern recognition objects belonging to the group containing said typical pattern recognition object;
grouping each pattern recognition object which is not selected as a typical object of a group to belong to the group of the typical pattern recognition object having a small correlation value between the typical object and the non-selected object;
grouping the pattern recognition objects obtained by performing the grouping and adding to the groups described above within a group; and
repeating these grouping steps a predetermined number of times to structure the pattern recognition objects into a hierarchical structure, said hierarchical structure being formed so that when recognizing an unknown pattern, only pattern recognition objects on a lower level of said hierarchical structure related to a pattern recognition object receiving a high score on a higher level of said hierarchical structure are searched.

8. The information forming method according to claim 7, further comprising the step of grouping said pattern recognition objects, whose correlation values are grouped in decreasing order, whose correlation values are below a predetermined value.

9. The information forming method according to claim 8, wherein said predetermined value is determined in accordance with a state of the grouping.

10. The information forming method according to claim 7, wherein the pattern recognition is voice recognition, and the pattern recognition object is a voice recognition objective word.

11. A voice recognizing apparatus comprising:

means for providing a plurality of voice recognition objective words;
means for structuring said voice recognition objective words into a hierarchical structure having a plurality of levels based upon correlation values indicative of similarities between each pair of voice recognition objective words;
means for inputting an unknown voice signal;
means for accumulating scores for the voice recognition objective words which are related in said hierarchical structure to a voice recognition word in a higher level, which word in said higher level receives a high score for said unknown input voice signal by using parameters which are calculated in advance; and
means for extracting and recognizing a corresponding voice recognition objective word to said unknown input voice signal.

12. The voice recognizing apparatus according to claim 11, wherein each pair of voice recognition objective words is arranged within said hierarchy in the order of increasing scores on the basis of values based on expected values of scores calculated by voice data corresponding to the recognition objective words.

13. A voice recognizing apparatus, comprising:

> means for providing a plurality of voice recognition objective words;
> means for structuring said voice recognition objective words into a hierarchical structure by using correlation values between each pair of voice recognition objective words;
> means for inputting an unknown voice signal;
> means for accumulating scores for the voice recognition objective words for said unknown input voice signal by using parameters which are calculated in advance;
> means for extracting and recognizing a corresponding voice recognition objective word to said unknown input voice signal;
> calculating means for calculating scores for said unknown input voice signal compared to the objective words, said calculating means calculating scores for voice recognition objective words of a proper, first hierarchy level in the hierarchical structure, calculating scores for words on a next hierarchy level immediately under the first hierarchy level associated with words having high scores in said first hierarchical level, calculating scores for words on a hierarchy level immediately under said next hierarchy level associated with words having high scores in said next hierarchical level, and repeating said score calculating until lowest hierarchy level is reached; and
> means for selecting at least a word having the highest score from the words whose scores are calculated.

14. The voice recognizing apparatus according to claim 13, further comprising:

> means for storing scores of words; and
> means for retrieving the stored scores to be used by said calculating means to prevent repetitive score calculation from being performed.

15. The voice recognizing apparatus according to claim 13, further comprising:

> means for preparing probability models for the plurality of voice recognition objective words;
> means for determining a plurality of state transition sequences on the basis of state transition probabilities of probability models corresponding to the voice recognition objective words;
> means for determining a symbol sequence for each state transition sequence on the basis of an output symbol probability corresponding to the state transition;
> means for calculating a generation probability of the obtained symbol sequences for probability models corresponding to the voice recognition objective words;
> means for structuring the voice recognition objective words into a hierarchical structure by using correlation values between each pair of voice recognition objective words based on the generation probability;
> means for generating probabilities of the unknown input voice signal in accordance with the probability models; and
> means for selecting a recognized corresponding voice recognition objective word according to the generated probabilities.

16. The voice recognizing apparatus according to claim 15, wherein said plurality of state transition sequences are determined on the basis of the probabilities of the probability models corresponding to the recognition objective words, each said symbol sequence is determined from each state transition sequence on the basis of an output symbol probability corresponding to the state transition, and said generation probabilities of the plurality of obtained symbol sequences are

calculated for the models corresponding to the words, comprising:

> means for arranging all the voice recognition objective words in the order of increasing expected values of the generation probabilities; and
> means for setting the correlation values between the pairs of voice recognition objective words in accordance with the relative positioning of the arranged voice recognition objective words.

17. A recording medium for recording information thereon, said recording medium having recorded thereon information of pattern recognition objects for use with a computing apparatus, said information of pattern recognition objects allowing said computing apparatus to recognize patterns by accumulating scores for the pattern recognition objects when compared to an unknown input pattern by using parameters which are calculated in advance, thereby allowing a corresponding pattern recognition object to be recognized, wherein said information of pattern recognition objects is determined by:

> determining correlation values between each pair of recognition objects;
> grouping the pattern recognition objects in decreasing order, on the basis of said correlation values;
> selecting a pattern recognition object serving as a typical object of each group;
> regrouping said pattern recognition objects to form groups each having a relationship between a typical pattern recognition object and a set of pattern recognition objects belonging to the group containing said typical pattern recognition object;
> grouping each pattern recognition object which is not selected as a typical object of a group to belong to the group of the typical pattern recognition object having a small correlation value between the typical object and the non-selected object; and
> grouping the pattern recognition objects obtained by performing the grouping and adding to the groups described above within a group; and
> wherein the pattern recognition objects are formed into a hierarchical structure, said hierarchical structure being formed so that when recognizing an unknown pattern, only pattern recognition objects on a lower level of said hierarchical structure related to a pattern recognition object receiving a high score on a higher level of said hierarchical structure are searched.

18. The recording medium according to claim 17, wherein said information of pattern recognition objects is further determined by grouping said pattern recognition objects, whose correlation values are below a predetermined value.
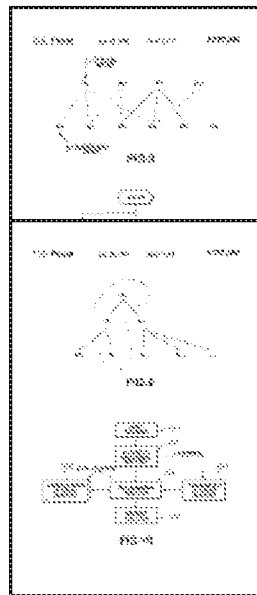
19. The recording medium according to claim 18, wherein said predetermined value is set in accordance with a state of the grouping.

20. The recording medium according to claim 17, wherein the pattern recognition is voice recognition, and the pattern recognition object is a voice recognition objective word.
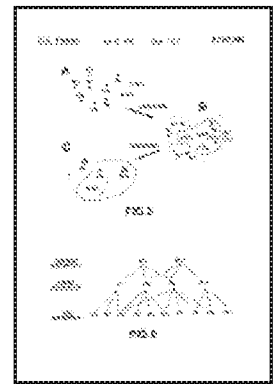
Drawings
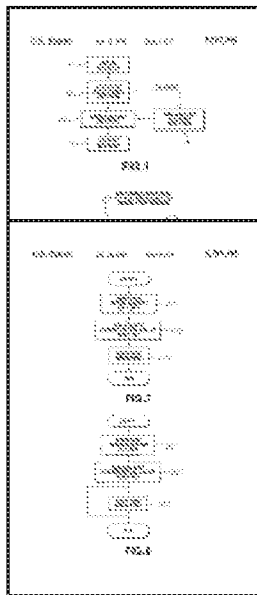
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